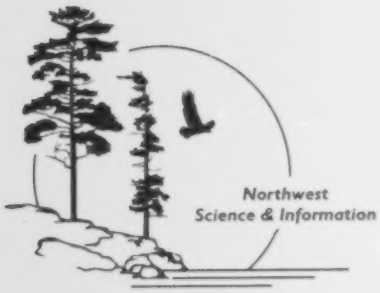

Lake of the Woods Open Water Creel Survey: 2002

NWSI Technical Report TR-135

December 2003

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by

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Abstract

An open water creel survey, employing a roving creel design with non-uniform probability sampling, was conducted on the Ontario waters of Lake of the Woods from May 18th until September 30th, 2002. Angling effort, which was estimated at 982,135 angler-hours ±123,184, increased by 28 percent over the last lake-wide creel estimate in 1999. Total harvest (162,510 kg) and walleye harvest (122,270 kg) were up 28 percent and 46 percent above 1999 harvest estimates. While angling effort increased in all sectors, with the exception of Sector 3 (Whitefish Bay), harvest declined in Whitefish and Sabaskong bays. Both effort and harvest peaked in the North Sector (Sector 1) where effort increased by 80 percent and walleye harvest increased by 250 percent from 1999 estimates. Overall, angling effort during the 2002 survey averaged 4.4 angler-hours·ha^{-1}, while harvest averaged 0.73 kg·ha^{-1} for all species and 0.55 kg·ha^{-1} for walleye. The significant increase in walleye harvest can be attributed to greater angling effort for this species since the average harvested size (0.54 kg) remained the same and walleye angling success rates (0.7 fish·angler-hr^{-1}) were only slightly higher than in 1999. Anglers reportedly released over 70 percent of all walleye caught in 2002. Manitoba-based daytrippers emerged as a distinct angling group in the 2002 survey and contributed to the large increase in effort observed in the North Sector. The representation of U.S.-based anglers in Sector 6 (Northwest Angle) increased from about 33 percent in 1999 to 64 percent of all interviewed anglers in 2002, following termination of the Border Waters Conservation licence in 2000.

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Disclaimer

The views, conclusions and recommendations are those of the author(s) and should not be construed as either policy or endorsement by the Ontario Ministry of Natural Resources.

Table of Contents

Page

Abstract iii
Acknowledgements iv
Disclaimer iv
List of Tables vi
List of Figures vii
Introduction 1
Methods 1
Results and Discussion 2
- Effort 2
- Harvest 3
- Catch-per-unit-effort (CUE) and Harvest-per-unit-effort (HUE) 6
- Angler Characteristics 7
  - Residency and Base of Operations 7
  - Species Preference 8
- Age and Size Compositions of the Harvest 10
  - Walleye 10
  - Other Species 10

Conclusions 12
Literature Cited 13

List of Tables

Page

Table 1 3
Estimated angling effort (angler-hrs) for various sectors, Lake of the Woods, Ont., during lake-wide creel surveys, May to September 1992–2002.

Table 2 3
Angling effort/pressure (angler-hrs·ha^{-1}) for various sectors, Lakes of the Woods, Ont. during May to September 2002.

Table 3 4
Estimated angling harvest (kg) by species from various sectors, during May to September 2002, Lake of the Woods, Ont.

Table 4 9
Angler responses, expressed by percent, to interview questions during the lake-wide creel survey, May to September 2002, Lake of the Woods, Ont.

List of Figures

Page

Figure 1 1
Location of Ontario sectors on Lake of the Woods.

Figure 2 3
A comparison of estimated angling effort (angler-hrs) by sector during May to September, 1992/93, 1999, and 2002, Lake of the Woods, Ont.

Figure 3 4
A comparison of walleye and total angling harvest (kg) estimated during lake-wide creel surveys, Lake of the Woods, Ont., May to September, 1983–2002.

Figure 4 5
A comparison of estimated walleye angling harvest (kg) by sector, Lake of the Woods, Ont., during May to September 1992/93, 1999, and 2002.

Figure 5 5
Percent composition of the estimated angling harvest (kg) by species, Lake of the Woods, Ont., during May to September 2002.

Figure 6 6
Percentage harvest by species and sector during the lake-wide creel survey, May to September 2002, Lake of the Woods, Ont.

Figure 7 7
A comparison of residency and base of operations of anglers interviewed during lake-wide creel surveys, May to September, 1993, 1999, and 2002, Lake of the Woods, Ont.

Figure 8 8
A comparison of angler composition by residency and base of operations from creel survey interviews during May to September 2002, Lake of the Woods, Ont.

Figure 9 9
Percent composition of estimated angling effort for targeted species during May to September in 1999 and 2002, for all sectors of Lake of the Woods, Ont.

Figure10 11
Age frequency comparison for walleye sampled from the angling catch during May to September in 1992/93, 1999, and 2002, Lake of the Woods, Ont.

Figure 11 11
Total length (mm) frequency comparison for walleye in the angling catch during May to September in 1992/93, 1999, and 2002, Lake of the Woods, Ont.

Introduction

A lake-wide creel survey was conducted on the Ontario portion of Lake of the Woods from May 18 (the opening of the walleye angling season) until September 30, 2002. Survey results allow comparison with previous Lake of the Woods open water creel surveys in 1977 (Alder 1979), 1983 (Mosindy 1984), 1985–1988, 1992, 1993 (Mosindy 1994), and 1999 (Mosindy 2002), and with Kenora District border waters creels that were conducted during 1994, 1995 and 1996 (Lockhart 1996).

All Ontario waters of Lake of the Woods (247,000 ha), with the exception of Shoal Lake, were covered during the 2002 survey. Lake of the Woods has been arbitrarily divided into seven sectors (including Shoal Lake) for fisheries assessment purposes, based on observed differences in physical and chemical characteristics, fish community, and user group patterns (Figure 1).

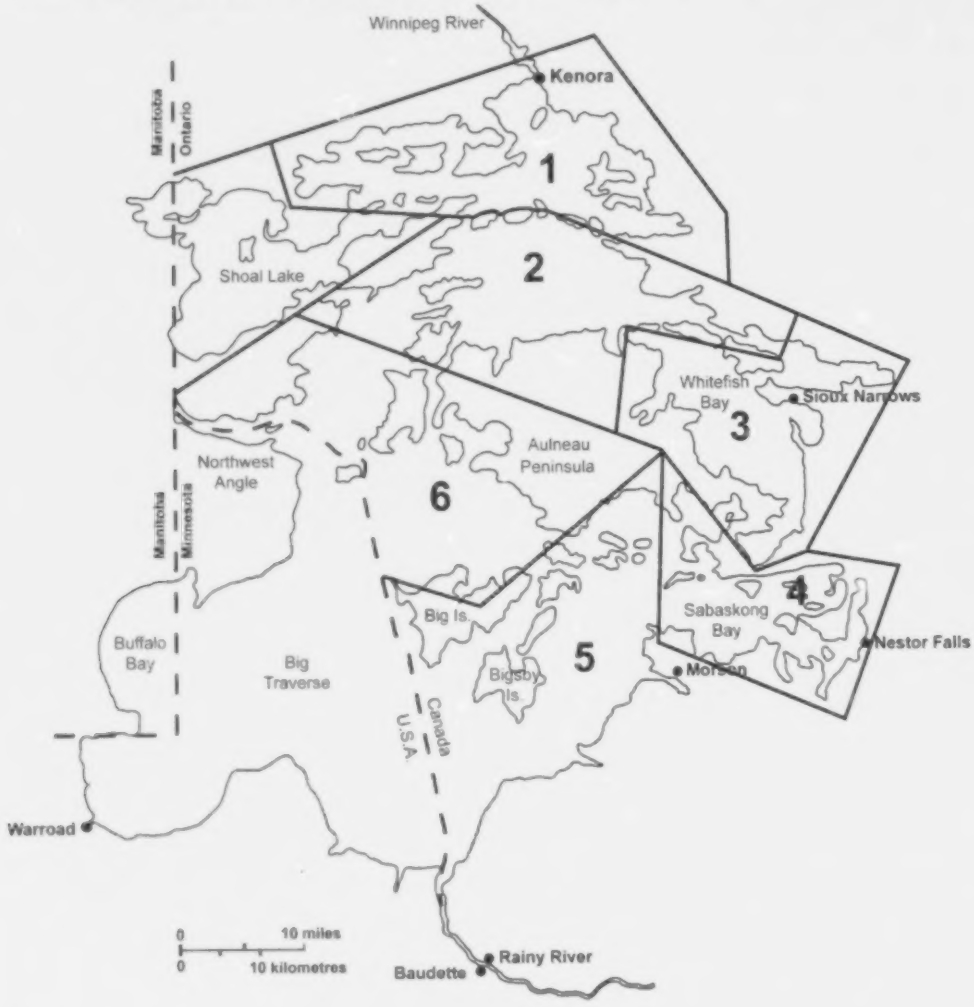


Figure 1. Location of Ontario sectors on Lake of the Woods.

Methods

A roving creel survey design with non-uniform probability sampling (Malvestuto *et al.* 1978) was used. Data were analyzed with CREESYS (Lester 1985, Orsatti *et al.* 1991), in order to estimate angling effort, catch and harvest by sector and by season. FISHNET 2.0 (Lester and Korver 1996) was used to

analyze fish attribute data from the angling harvest.

Spatial and temporal stratification were employed. Sectors were divided into smaller sampling units or sub-sectors (Figure 1), owing to a survey requirement that creel crews be able to provide coverage of the entire area within a one-hour period, for the purposes of an instantaneous boat count. While equal priority was assigned to each sector, sampling effort was stratified amongst the sub-sectors. The creel survey period was divided into three distinct seasons: spring (May 18th to June 30th); summer (July 1st to August 15th); and late summer – fall (August 16th to September 30th). Workdays (weekdays) and non-workdays (weekends and holidays) were treated the same, since the majority of anglers in all sectors were identified as tourists. Daily coverage ran for a twelve-hour period from 08:00 to 20:00 hours. A day was divided into two time periods, corresponding to observed differences in angling pressure: an a.m. period from 08:00 to 14:00 hours and a p.m. period from 14:00 to 20:00 hours. Only one spatial and temporal unit was sampled during each survey day. Effort probabilities were based on observed distributions of angling parties (boats) on the lake during aerial frame surveys that were conducted seasonally throughout the study period. Two aircraft flying simultaneously provided coverage of the entire lake within a three-hour period. This information was used to determine the number of areas and time periods to be sampled in a particular season. Sampling days and areas were randomly selected for each.

Creel crews interviewed a subsample of anglers, proportional to the time available to cover a sampling unit, during each survey day. The total number of angler-hours fished per boat, the residency of anglers, their visitor type and base of operations (e.g. guest of a Canadian or American resort, cottager, etc.) were established. In addition, anglers were asked a number of optional questions, outside of the standard interview format, that could be used to characterize current angling practices and activities related to the fishing trip. All fish kept by anglers were tallied and weighed by species. The total length and appropriate tissues for age interpretation (Mann 1993) were taken from a random subsample of the catch.

Results and Discussion

Effort

A total of 1,157 angling parties were contacted and 2,976 anglers were interviewed from May 18th to September 30th, 2002.

It was estimated that angling effort for the survey period totalled 982,135 angler-hours ±123,184 (at a 95% confidence level) or 4.4 angler-hours·ha^{-1}. This represents a 28 percent increase over the last lake-wide creel estimate of 769,230 angler-hrs for the same period in 1999 (Mosindy 2002).

Differences were observed in angling effort between sectors and with past lake-wide surveys (Figure 2, Table 1). In 2002, the greatest effort occurred in Sector 1 (255,772 angler-hrs), followed by Sector 2 (Central) and Sector 4 (Sabaskong Bay). The Central Sector (2) accounted for the most angling effort during lake-wide surveys in 1992, 1993 and 1999, followed by Sabaskong Bay (4), the North Sector (1), and Whitefish Bay (3). In a comparison with 1999 creel results, effort in 2002 increased in all sectors, with the exception of Sector 3 where it had declined by 17 percent. The largest increases occurred in Sector 1 (80%) and Sector 4 (50%). Effort had increased slightly in the South Sectors, Sector 5 (12%) and Sector 6 (8%), over 1999 estimates.

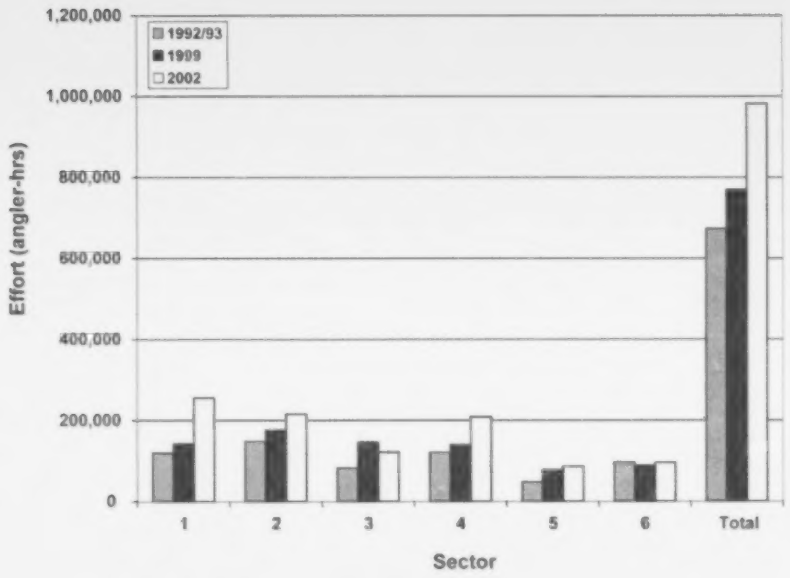


Figure 2. A comparison of estimated angling effort (angler-hrs) by sector during May to September, 1992–93, 1999, and 2002, Lake of the Woods, Ont.

	Sector						
Year	1	2	3	4	5	6	Total
1992	119,640	121,200	45,550	80,170	29,270	62,890	458,720
1993	119,760	175,890	119,140	161,750	66,050	128,280	771,870
1999	142,740	176,000	146,080	139,680	76,280	88,450	769,230
2002	255,772	215,609	121,773	208,198	85,440	95,393	982,135

Table 1. Estimated angling effort (angler-hrs) for various sectors, Lake of the Woods, Ont., during lake-wide creel surveys, May to September 1992–2002.

Angling effort or pressure, expressed as angler-hrs·ha^{-1}, was greatest in Sabaskong Bay, which has remained the most heavily fished sector on the lake through past creels. Angling effort ranged from 1.2 angler-hrs·ha^{-1} in South Sector 5 to 11.4 angler-hrs·ha^{-1} in Sector 4 (Table 2).

	Sector						
	1	2	3	4	5	6	All
Surface area (ha)	29,450	40,300	20,600	18,240	71,690	42,000	222,290
Effort (angler-hrs·ha^{-1})	8.7	5.4	5.9	11.4	1.2	2.3	4.4
Yield (kg·ha^{-1})							
All species	1.49	1.09	1	1.28	0.23	0.36	0.73
Walleye	1.39	0.96	0.23	0.68	0.17	0.32	0.55

Table 2. Angling effort/pressure (angler-hrs·ha^{-1}) for various sectors, Lake of the Woods, Ont. during May to September 2002.

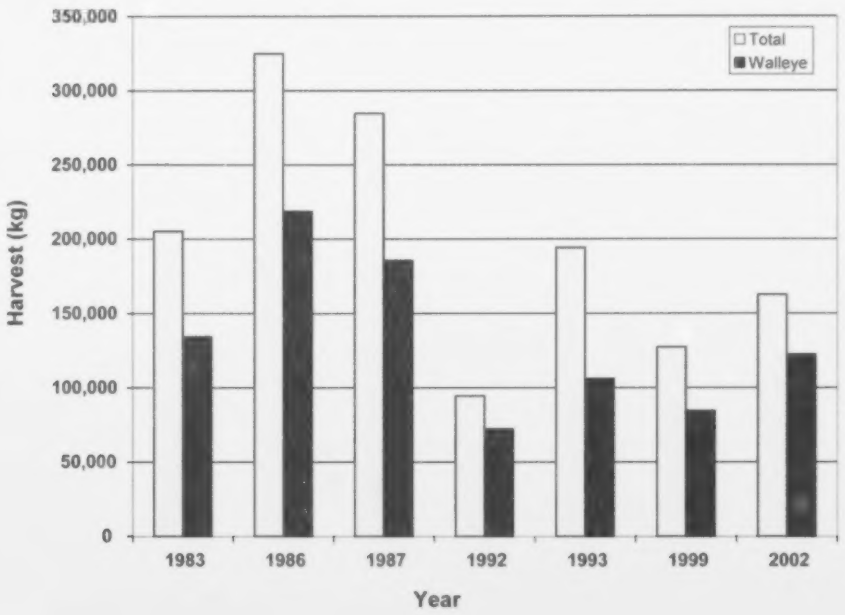
Harvest

Total angling harvest was estimated at 162,510 kg during the 2002 lake-wide creel (Table 3, Figure 3). This represents a 28 percent increase above the 1999 estimate of 127,240 kg but was lower than the 1993 harvest estimate of 194,200 kg. Angling harvest estimates in previous surveys have ranged from 94,470 kg in 1992 to 324,820 kg in 1986.

Table 3. Estimated angling harvest (kg) by species from various sectors, during May to September 2002, Lake of the Woods, Ont.

	Harvest by Species (kg)							
Sector	**Walleye**	**Sauger**	**Y.Perch**	**N.Pike**	**SMBass**	**B.Crappie**	**L.Trout**	**Total**
1	40,810	200	700	1,480	640	0	0	43,830
2	38,630	550	2,750	1,560	190	30	0	43,710
3	4,780	0	0	7,780	3,130	0	4,820	20,510
4	12,370	170	1,220	4,590	1,150	3,700	0	23,200
5	12,330	110	240	140	400	2,970	0	16,190
6	13,350	0	840	260	250	240	0	14,940
Total	**122,270**	**1,030**	**5,750**	**15,810**	**5,760**	**6,940**	**4,820**	**162,510**

Figure 3. A comparison of walleye and total angling harvest (kg) estimated during lake-wide creel surveys, Lake of the Woods, Ont. May to September, 1983-2002.



Walleye continued to dominate angling harvest from this lake, representing 75 percent of the total harvest by weight in 2002. This species comprised 54 percent and 66 percent of the total harvest weight in 1993 and 1999 (Figure 3). It was estimated that 122,270 kg of walleye were taken during the 2002 survey, which was up 46 percent above the 1999 harvest estimate of 84,310 kg. Walleye harvests increased in all areas (Figure 4), except Sectors 3 (Whitefish) and 4 (Sabaskong Bay). The highest walleye harvests occurred in Sector 1 (40,800 kg) and Sector 2 (38,630 kg). Sector 1 accounted for the greatest increase over the 1999 survey estimate at 250 percent.

Northern pike were the second most important species in 2002, representing about 10 percent of the estimated harvest weight or 15,810 kg (Figure 5, Table 3). Northern pike were most important in Sector 3 (Whitefish Bay) where they comprised 38 percent of the estimated harvest by weight, followed by Sector 4 (Sabaskong Bay) at 20 percent (Figure 6).

Other species in the overall harvest (Tables 3, Figure 6) included black crappies (4.3%), yellow perch (3.6%), bass (3.5%), and lake trout (3%). No muskies were observed in the angling catch during this creel survey. Black crappie were important in the angling harvest in Sectors 4 and 5 where they represented 16 percent (3,700 kg) and 18 percent (2,970 kg) of the harvest by weight (Figure 6). Yellow perch increased in importance in the catch from all areas, epecially

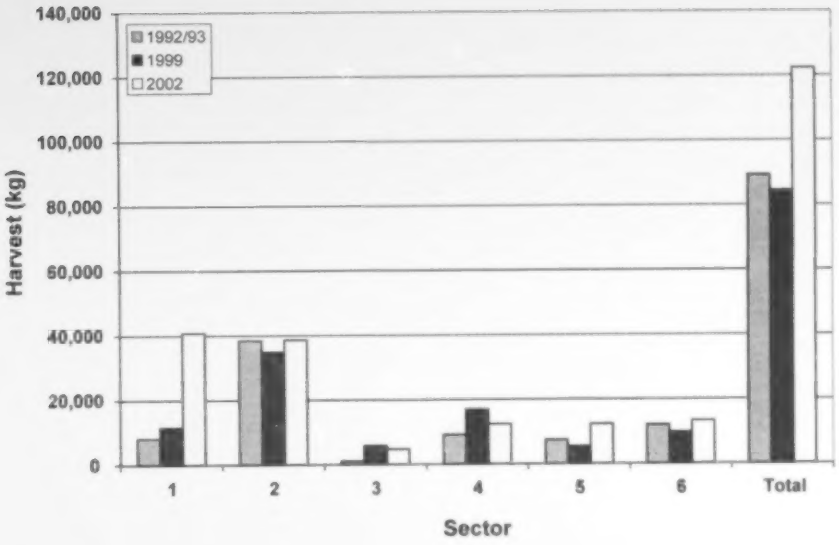
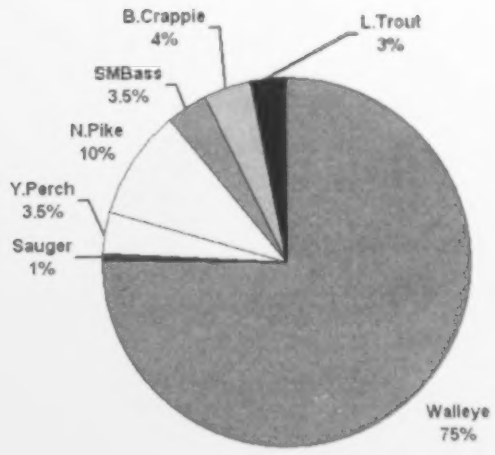


Figure 4. A comparison of estimated walleye angling harvest (kg) by sector, Lake of the Woods, Ont., during May to September 1992/93, 1999, and 2002.



Total Harvest = 162,510 kg

Figure 5. Percent composition of the estimated angling harvest (kg) by species, Lake of the Woods, Ont., during May to September, 2002.

Sectors 2, 4 and 6. Smallmouth bass were most important in Sabaskong and Whitefish Bays where they represented five percent and 15 percent of the total harvest. Lake trout were a major component in the angling harvest only from Whitefish Bay (Sector 3) where they comprised about 24 percent of the harvest or 4,800 kg. Sauger formed a minor fraction of the harvest from most sectors.

Angling yields during the survey period averaged 0.73 kg·ha^{-1} for all species and 0.55 kg·ha^{-1} for walleye. Overall yields ranged from 0.23 kg·ha^{-1} in Sector 5 to 1.49 kg·ha^{-1} in Sector 1 (Table 2). Walleye angling yields ranged from 0.17 kg·ha^{-1} in Sector 5 to 1.39 kg·ha^{-1} in Sector 1.

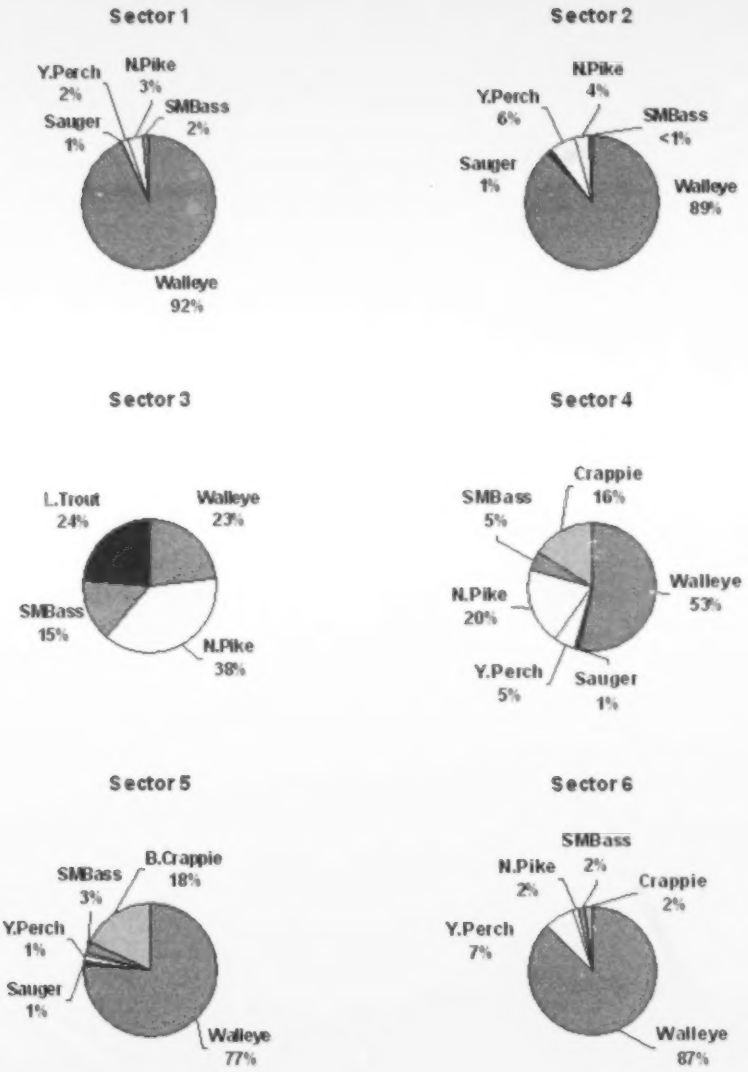


Figure 6. Percentage harvest by species and sector during the lake-wide creel survey, May to September 2002, Lake of the Woods, Ont.

Catch-per-unit-effort and Harvest-per-unit-effort

An overall catch-per-unit-effort (CUE) of 1.42 fish·angler-hr^{-1}, based on the total number of fish of all species caught throughout the lake, was observed during the 2002 creel. The corresponding harvest-per-unit-effort (HUE) was 0.165 kg·angler-hr^{-1}. These values were slightly higher than those observed in 1999 (i.e. CUE of 1.02 fish·angler-hr^{-1} and an HUE of 0.16 kg·angler-hr^{-1}). Walleye CUEs and HUEs averaged 0.7 fish·angler-hr^{-1} and 0.124 kg·angler-hr^{-1} throughout the lake, as compared to 0.63 fish·angler-hr^{-1} and 0.135 kg·angler-hr^{-1} in 1999.

Although walleye CUEs were generally higher in 2002 than in 1999 and in previous lake-wide surveys (Mosindy 2002), harvest rates were lower. This can partly be attributed to higher release rates reported by anglers during recent creel interviews. It was estimated that anglers released 70 percent of walleyes reportedly caught in 2002, as compared to 60 percent in 1999 and 40 percent in 1992. Higher walleye release rates in 2002 than in 1999 may reflect a lower daily catch limit for non-resident anglers (both Ontario and

Minnesota-based) that was established in the year 2000. A strong 2001 year class was also recruiting to the angling fishery during the summer of 2002 and anglers would have encountered greater numbers of small-sized, less desirable walleyes in their catch.

Angler Characteristics

Residency and Base of Operations

Ontario non-residents continued to dominate this fishery and represented about 90 percent of all anglers contacted during the 2002 creel survey. Eighty percent of all anglers were from the United States (U.S.), 10 percent were from Ontario while the remaining 10 percent were from other Canadian provinces, especially Manitoba. The representation of Manitoba residents has increased in recent years, from 5.5 percent of all anglers in 1983 (Mosindy 1984), 7.5 percent in 1999 (Mosindy 2002) and 10 percent in 2002.

Non-residents who were guests at Ontario resorts comprised 62 percent of anglers, the largest single group (Figure 7). Non-residents staying at private cottages in Ontario increased to 16 percent of all anglers interviewed during the 2002 survey, as compared to eight percent in 1993 and 10 percent in 1999. This group accounted for a significant portion of anglers in traditional cottaging areas such as Sector 1 (31%) and Sector 3 (14%), but also in Sector 2 (17%), a less heavily developed area (Figure 8).

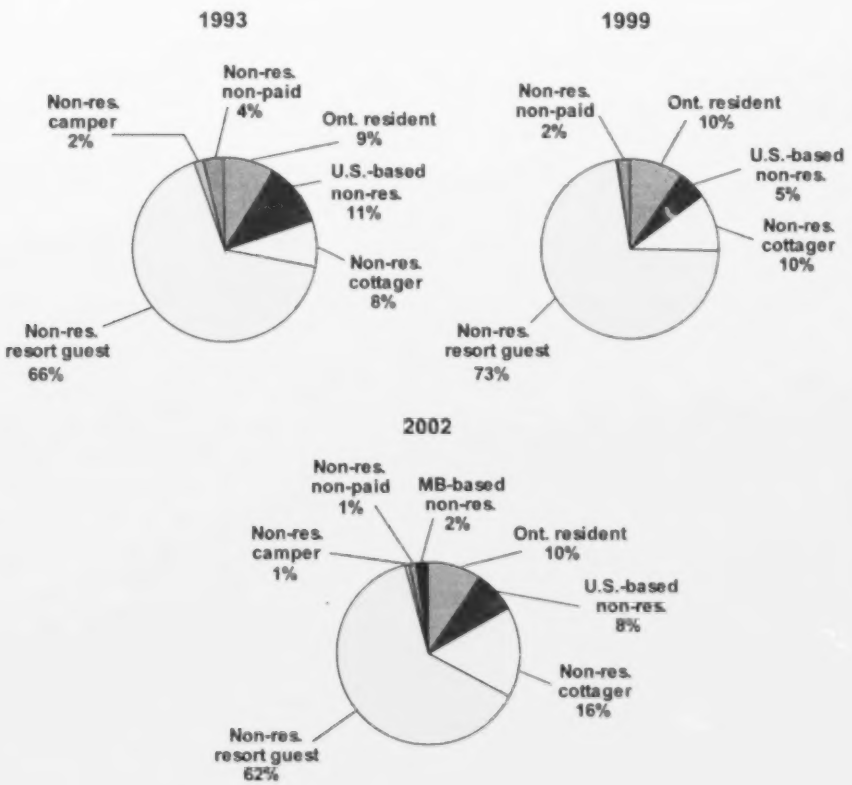
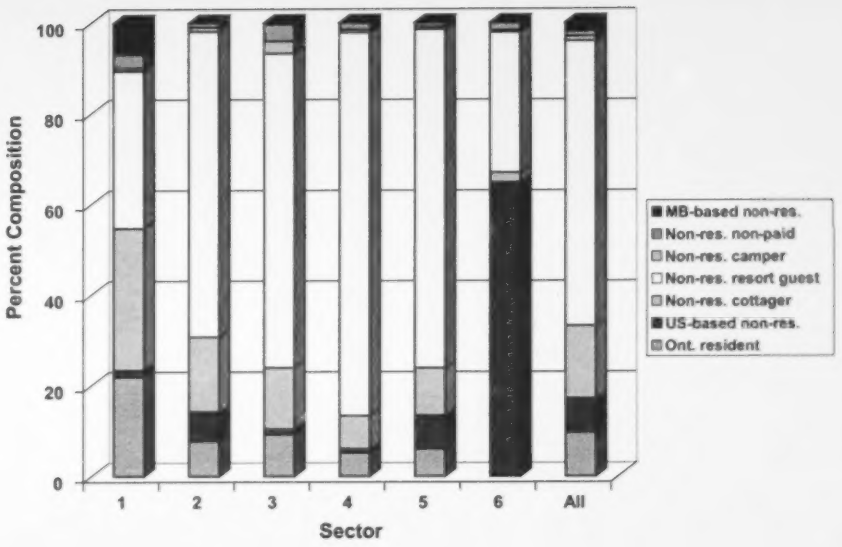


Figure 7. A comparison of residency and base of operations of anglers interviewed during lake-wide creel surveys May to September, 1993, 1999, and 2002, Lake of the Woods, Ont.

Figure 8. A comparison of angler composition by residency and base of operations from creel survey interviews during May-September 2002, Lake of the Woods, Ont.



U.S.-based non-residents (day-trippers) comprised 7.5 percent of all anglers contacted in 2002, which was up from five percent in 1999 (Mosindy 2002). The representation of Minnesota daytrippers increased in Sectors 2, 5 and 6 which are closest to the U.S. border. The most significant increase occurred in Sector 6 where this group comprised 64 percent of all anglers contacted in 2002, as compared with 33.5 percent in 1999. The cancellation of the Border Waters Conservation Licence program in year 2000 would account for the observed increase in U.S.-based effort in Ontario waters during the 2002 survey. The walleye/sauger daily catch limit for U.S.-based non-residents was reduced to zero in 1998, as part of this program. This was largely responsible for the subsequent decline in U.S.-based representation in Sector 6 and throughout the lake during the 1999 survey (Mosindy 2002).

Manitoba-based anglers emerged as a distinct angler group in the 2002 creel, representing almost two percent of all anglers contacted and over seven percent of all anglers interviewed in Sector 1, the area closest to Kenora (Figure 8).

Species Preference

Walleye anglers remained the single largest group interviewed in all survey areas, except Sector 3. They contributed 46 percent of all estimated angling effort (Figure 9) during this survey. Northern pike and bass (both smallmouth and largemouth) were the next most sought after species, accounting for 15 percent and 14 percent of all estimated angling effort. Both northern pike and bass angling were most important in Sector 3, followed by Sector 4 and 6. Angling for muskies and lake trout comprised nine percent and four percent of all estimated effort in Ontario waters (Figure 9). Muskie angling was most important in Sectors 4 and 6 where effort for this species accounted for 14 percent and 16 percent of the total in each, respectively. Lake trout angling occurred only in Sectors 1 and 3 where it represented 10 percent and 14 percent of all estimated effort. While angling for black crappies comprised four percent of all effort lake-wide, it was most important in Sectors 4 (7%) and 5 (14%). Angling effort targeted for yellow perch increased from about three percent in 1999 to over seven percent of all effort during the 2002 survey.

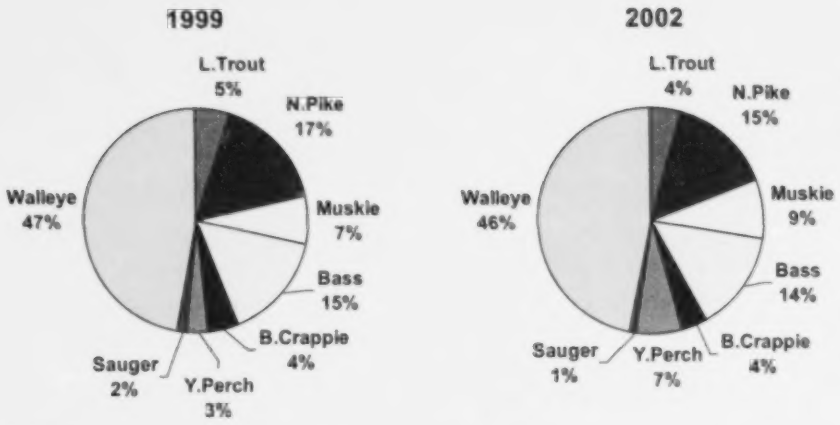


Figure 9. Percent composition of estimated angling effort for targeted species during May-September in 1999 and 2002, for all sectors of Lake of the Woods, Ont.

Other

Angler responses to optional interview questions provided information and insights into current angling practices and characteristics of this fishery (Table 4).

Table 4. Angler responses, expressed by percent, to interview questions during the lake-wide creel survey, May to September 2002, Lake of the Woods, Ont.

1. Do you have a livewell on your boat?

	Sector						
% Response	1	2	3	4	5	6	Total
Yes	77.5	92	77.5	82	71	90	82
No	22.5	8	22.5	18	29	10	18

2. Will you or did you have a shorelunch today?

	Sector						
% Response	1	2	3	4	5	6	Total
Yes	9	37	14	18	32	25	22
No	91	63	86	82	68	75	78

3. Are you using the services of a guide?

	Sector						
% Response	1	2	3	4	5	6	Total
Yes	4	39	13	12	15	12	17
No	96	61	87	88	85	88	83
# interviewed	617	705	436	670	316	232	2976

Eighty-two percent of all anglers interviewed by creel survey crews were fishing from boats equipped with livewells, although this varied from 71 to 92 percent by sector (Table 4). Livewells are used by anglers to keep their catch alive out of the water. Their use has increased over the last two decades on Lake of the Woods, as elsewhere. Livewells also allow anglers to sort or "cull" their catch whereby larger fish are kept and smaller ones are released over the duration of the fishing trip. This practice is not illegal in Ontario but it does pose a management concern since some species, notably walleye, are especially vulnerable to stress from handling and delayed-release. Armstrong (1995) noted delayed-release mortality rates for walleye, directly related to the use of livewells under tournament conditions, ranging from 21 to 66 percent in a review of the literature. Factors such as the type of livewell system used

(e.g. circulating, aeration), water temperature, O_2 concentrations, crowding and the duration of captivity in the livewell, along with wave conditions during the angling event can influence walleye mortalities.

Twenty-two percent of all interviewed anglers had or planned on having a shorelunch out on the water, consisting of fish caught that day. This varied by sector, ranging from about nine percent in Sector 1 to 37 percent in Sector 2 (Table 4). Shorelunches appeared to be most popular on sectors that were furthest removed from a direct base of operations and involved considerable travel to reach popular fishing locations within them (i.e. Sectors 2, 5 and 6). Although shorelunches are a popular activity, fish caught that day and eaten are considered part of one's daily catch limit.

Seventeen percent of all anglers were using the services of a guide at the time of interview (Table 4). The percentage of guided anglers ranged from about four percent in Sector 1, the sector with the highest resident and non-resident cottager component, to 39 percent in Sector 2 where the majority of tourist anglers travel from resorts located in the Sioux Narrows area on Whitefish Bay. It is interesting to note that Sector 2 had both the highest number of shorelunch responses and guided party rates of any sector. It would appear that shorelunches are an integral part of a guided fishing trip on the lake. The percentage of guided anglers on Lake of the Woods has varied over time from about 12 percent in 1983 (Mosindy 1984) to 19 percent in 1992, 20 percent in 1999, and 17 percent in 2002.

Age and Size Compositions of the Harvest

Walleye

Walleye averaged 390 mm total length, 0.55 kg in weight and 4.2 years of age in the observed angling catch sample. Although the average age of fish in 2002 was slightly older than in the 1999 sample, their average length and weight were similar to those observed in previous years. The majority of fish were between 300–400 mm in length and three to five years of age (Figure 10 and 11). The largest single age group in the catch was comprised of three-year olds (37%), representing a strong 1999 year class. Walleyes ≥ 450 mm and ≥ 6 years old comprised about 17 percent of the observed catch in 2002, as compared to 12 percent in 1999 and 22 percent of the catch in 1992/93.

Other Species

Northern pike averaged 629 mm (TL), 1.52 kg and 4.2 years old in the total catch sample from all sectors. All age groups from two to seven years were represented.

Smallmouth bass averaged 355 mm (TL), 0.66 kg and 5.8 years old in the lake-wide catch sample. All age groups from three to eight years were represented. Most sampled fish were between 350–400 mm in length.

The *black crappie* catch was dominated by fish ≥ 250 mm (TL) and 4 years old. Age groups three to 11 years were represented in the sample. The mean age and size of black crappies were 4.9 years old, 272 mm (TL) and 0.32 kg in weight.

Yellow perch averaged 237 mm in length, 0.17 kg in weight and 6.1 years old in the catch sample. All age groups from three to 10 years were present, although age 6 fish which comprised over 33 percent of the sample were the largest single age group.

A limited number of *lake trout* (n=17), entirely from Whitefish Bay were sampled from the angling catch. The mean size and age of these were 609 mm (TL), 2.29 kg in weight and 7.9 years old. Although fish ranged in age from four to 17 years, five-year-olds (1997 year-class) which comprised over 35 percent of the sample were the single largest age group in the catch.

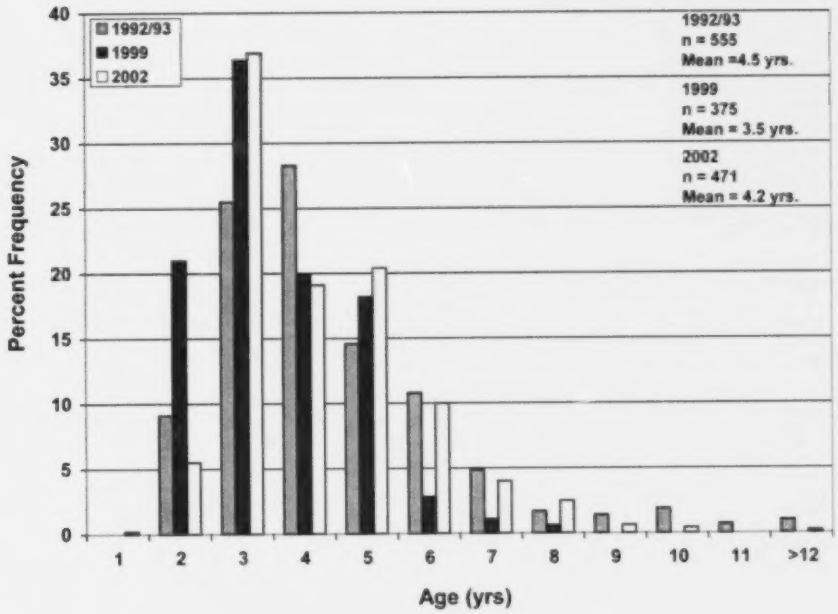


Figure 10. Age frequency comparison for walleye sampled from the angling catch during May to September in 1992/93, 1999, and 2002, Lake of the Woods, Ont.

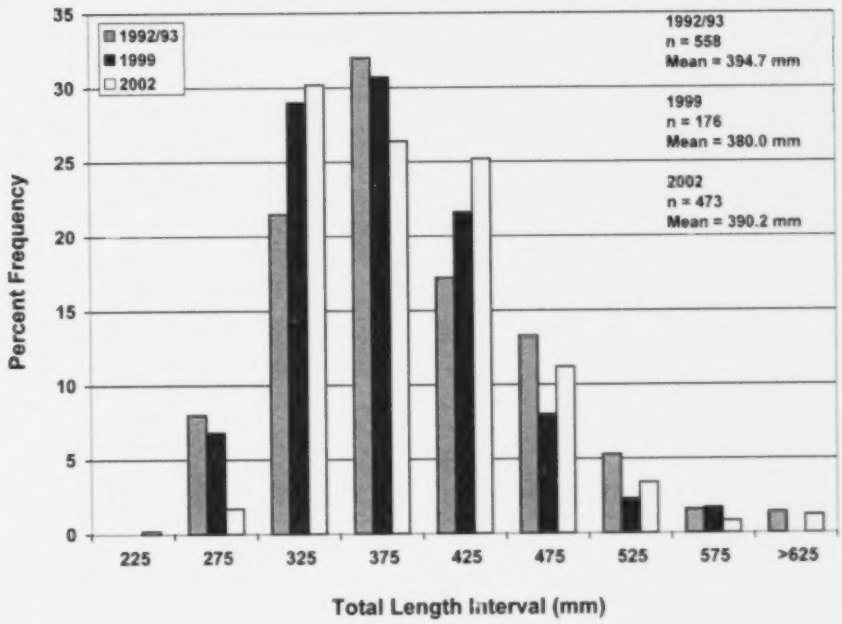


Figure 11. Total length (mm) frequency comparison for walleye in the angling catch during May to September in 1992/93, 1999, and 2002, Lake of the Woods, Ont.

Conclusions

Both angling effort and harvest increased by 28 percent over similar estimates from the last survey in 1999. While angling effort increased in all sectors except Whitefish Bay, the largest increases occurred in the North Sector and Sabaskong Bay. Non-resident property owners and Manitoba-based daytrippers contributed to the large increase in effort observed in the North Sector. Although representation of U.S.-based anglers increased from five to eight percent overall, the most significant increase occurred in Sector 6 (Northwest Angle) where this group made up 64 percent of all anglers contacted in 2002, as compared to 33.5 percent in 1999. This marked a return in U.S.-based participation in this sector to pre-1994 levels and can partly be attributed to the termination of the Border Waters Conservation licence in year 2000. This licence, in addition to a non-resident angling licence, was required by U.S.-based anglers when fishing in Ontario waters of the lake. The daily walleye/sauger catch limit for non-resident anglers on Lake of the Woods, whether Ontario or Minnesota-based, is currently two fish per day with four in possession. Prior to year 2000, U.S.-based anglers had a zero daily catch and possession limit for walleye and sauger when fishing in Ontario sectors.

A significant increase in total harvest (162,510 kg) above the 1999 survey estimates was largely due to an increase in walleye harvest. This can be primarily attributed to an increase in directed effort for this species since the average size of walleye in the angling catch (0.54 kg) had not changed and walleye angling success rates were only marginally higher than in 1999. In fact, harvest rates (0.124 kg·angler-hr^{-1}) were slightly lower than those observed in 1999 (0.135 kg·angler-hr^{-1}). Anglers reportedly released over 70 percent of all walleye caught in 2002 and continued a trend to increased catch and release angling for this species, first noted in the early 1990s.

Angling harvests and targeted effort in all sectors continued to be dominated by walleye, with the exception of Sector 3 (Whitefish Bay) where northern pike were more important. Overall, walleye accounted for 75 percent of the total harvest by weight and 46 percent of all effort. Fisheries for other species remained largely unchanged from the 1999 survey results. Musky angling which represented nine percent of all targeted effort has continued to grow in popularity in most sectors. Yellow perch, which accounted for almost four percent of the total harvest and seven percent of targeted effort in 2002, had also increased in importance from the previous survey.

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